

CLAIMS

1. A cooling device for an electronic equipment, comprising:
a cooling panel (2) including a bottom heat radiation plate (23) and a top heat radiation plate (24), at least one of which is provided with a groove (231), said bottom heat radiation plate (23) and top heat radiation
5 plate (24) being bonded together to form a passage (21) of refrigerant; and
a circulation pump (3) fixed onto said cooling panel (2) to circulate said refrigerant through said passage (21) for radiating heat transferred to said cooling panel (2).
2. The cooling device for an electronic equipment according to claim 1, wherein said circulation pump (3) is a piezoelectric pump.
3. The cooling device for an electronic equipment according to claim 2, wherein said piezoelectric pump (3) includes a pump housing (321) defining a pump chamber (319) receiving therein a piezoelectric vibration plate (313), and said pump housing (321) is fixed onto said cooling panel
5 (2) so that a discharge port (316) and a suction port (315) are aligned with said inlet port (27) and said outlet port (26), respectively.
4. The cooling device for an electronic equipment according to claim 2, wherein a check valve (317) is provided in operative relationship with each

of said discharge port (316) and said suction port (315), and said check valve (317) is fixed onto a member (322) which is detachably attached
5 onto said pump housing (319).

5. The cooling device for an electronic equipment according to claim 3, wherein said piezoelectric vibration plate (313) has a bimorph structure including an elastic circular plate and a pair of piezoelectric ceramic circular plates sandwiching therebetween said elastic circular plate and
5 polarized in opposite directions to each another, each of said pair of piezoelectric ceramic circular plates has a layered structure including a plurality of ceramic layers, and adjacent two of said ceramic layers in said layered structure are polarized in opposite directions to each other.

6. The cooling device for an electronic equipment according to claim 1, wherein said piezoelectric vibration plate (313) includes a pair of first piezoelectric ceramic elements not polarized, a pair of second piezoelectric ceramic elements sandwiching therebetween said first piezoelectric
5 ceramic elements and polarized in opposite directions to each other, and a pair of third piezoelectric ceramic elements disposed outside said second piezoelectric ceramic elements and not polarized, and wherein each of said second piezoelectric ceramic elements has a layered structure including a plurality of ceramic layers, adjacent two of said ceramic layers in said
10 layered structure are polarized in opposite direction to each other, and said

first through third piezoelectric ceramic elements are sintered to form an integral structure.

7. The cooling device for an electronic equipment according to claim 1, wherein a reinforcement (22, 22A) is formed in said groove (231) for reinforcing bonding of said bottom heat radiation plate (23) and said bottom heat radiation plate (24).

8. The cooling device for an electronic equipment according to claim 1, further comprising a reservoir (4, 411) communicated with a branch hole (43, 412) formed in said passage (21) and fixed onto said top heat radiation plate (24) of said cooling panel (2).

9. The cooling device for an electronic equipment according to claim 8, wherein a taper portion (41) of a circular truncated cone or truncated pyramid having an apex at an exit of said branch hole (43) is formed on a bottom surface of said reservoir (4).

10. The cooling device for an electronic equipment according to claim 9, wherein a volume of said reservoir (4) below said apex of said taper portion is larger than a volume of said reservoir above said apex of said taper portion (41), and said refrigerant fills said reservoir (4) so that a liquid level is located above said apex of said taper portion (41).

11. The cooling device for an electronic equipment according to claim 9, wherein a protrusion (42) having an area smaller than a cross-sectional area of said branch hole (43) is formed on top of said reservoir (4) at a position opposing said branch hole (43).

12. The cooling device for an electronic equipment according to claim 1, wherein a portion of said passage (21) is replaced by a micro-channel structure (12) including a plurality of narrow grooves having a width smaller than a width of said groove (231).

13. The cooling device for an electronic equipment according to claim 11, wherein a guide plate (161, 162, 163) is formed between said passage (21) and said micro-channel structure (12) for enlarging flow of said refrigerant from a width of said passage up to a width of said micro-channel structure.

14. The cooling device for an electronic equipment according to claim 11, wherein said guide plate includes a plurality of guide plates, and wherein one (161) of said guide plates is longer than another (162, 163) of said guide plates located at downstream of said one (161) of said guide plates, and has a larger angle with respect to a flow direction of said refrigerant than said another (162, 163).

15. The cooling device for an electronic equipment according to claim 1, wherein said passage (21) is coated with metal.

16. A cooling device for an electronic equipment, comprising a substrate (20), a passage embedded in said substrate (20) and passing therethrough refrigerant, a circulation pump (3) disposed on a surface of said substrate (2), and a reservoir (4, 4111) communicated with said first
5 passage via a branch hole, wherein said circulation pump (3) circulates said refrigerant through said passage (21) to radiate heat transferred to said substrate (20).

17. The cooling device for an electronic equipment according to claim 16, wherein said reservoir (4) is a laid-down-type reservoir fixed onto said surface of said substrate (20).

18. The cooling device for an electronic equipment according to claim 16, wherein said reservoir (411) is a standing-rest-type reservoir embedded within said substrate (20).

19. An electronic equipment mounting thereon the cooling device for electronic equipment according to any one of claims 1 to 18.